Competency 2.10 **Radiation protection personnel shall demonstrate a familiarity level knowledge of the Federal regulations, guidelines, and Orders pertaining to the decontamination and decommissioning of nuclear facilities.**

1. Supporting Knowledge and/or Skills

a. Discuss the application of the Department's Guidelines for Formerly Utilized Sites Remedial Action Program (FUSRAP) established in 1974 and the Surplus Facilities Management Program (SFMP) established in 1978.

b. Discuss the role of radiation protection personnel with respect to the Radiological Guidelines for Application to the Department's Formerly Utilized Sites Remedial Action Program (ORO-831, March 1983).

c. Discuss the contents of the responsibilities and requirements sections of DOE Order 5820.2A, *Radioactive Waste Management.*

2. Summary

During the 1940s and 1950s U.S. Army Corps of Engineers Manhattan Engineer District (MED) and its successor, the U.S. Atomic Energy Commission (AEC), conducted a program involving research, development, processing, and production of uranium and thorium. Storage of radioactive ores and processing residues (e.g., mill tailing) was also included in this program. Most of this work was performed by private contractors for the government on land that was either federally, privately, or institutionally owned.

This early, rather large, nuclear program was conducted with a great sense of urgency and limited available knowledge regarding the radioactive characteristic of uranium ore and the residual material produced from its processing. Therefore, many of these sites became contaminated with radioactivity.

DOE implemented a program to evaluate and, where necessary, take action to protect the public from contamination at sites that were used in the past to process and/or store radioactive materials for the former U.S. Army Corps of Engineers Manhattan Engineer District (MED) or the U.S. Atomic Energy Commission (AEC). This program is identified as the Formerly Utilized Sites Remedial Action Program (FUSRAP).

The FUSRAP program formally began in 1974. Radiological surveys and other research work had been conducted by the AEC and its successors, the ERDA and the DOE, under the implied authority of the Atomic Energy Act of 1954, as amended. The intent of Congress, as expressed in the FY 1978 DOE Authorization Act was that, at the completion of this program, the DOE would seek additional legislative authority, pursuant to a Congressional review of findings, for the undertaking of any required remedial action work.

The objectives of the FUSRAP program were to:

- Identify former MED/AEC sites
- Characterize their radiological condition
- Decontaminate the sites as required and pursuant to authorization and appropriation by Congress
- Develop acceptable disposal and stabilization sites in consultation with the affected states, and ultimately
- Certify the acceptability of the sites for future use.

In 1978, the Surplus Facilities Management Program (SFMP) was established for the coordinated management of the decommissioning of surplus contaminated DOE facilities. The Richland Program Office issued the SFMP Resource Manual to serve as the management guide. The principal directive for the program was DOE Order 5820.2, *Radioactive Waste Management*. Radiological release criteria were established on a case by case basis in conformance with DOE Order 5400.5, *Radiation Protection of the Public and the Environment*. In 1982, the single program was divided. The civilian (or nuclear energy) program, which continued to be managed by the SFMP, relocated to DOE Headquarters in Washington, D.C. For surplus facilities from the national defense programs, decommissioning was directed through the Defense Facilities Decommissioning Program Office located in Richland, WA.

The SFMP Resource Manual continued to be the principal management guidance for the civilian program. The defense program issued the Defense Decontamination and Decommissioning Program: Program Management Plan (DOE/RL-89-93).

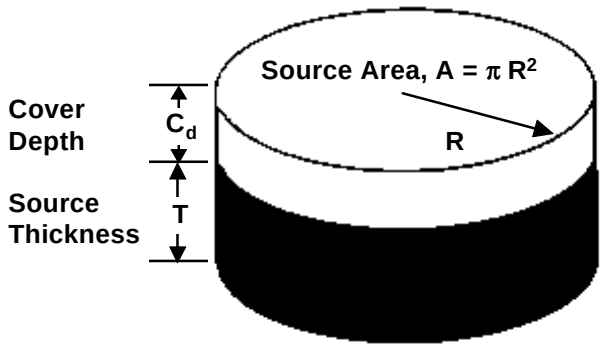
ORO-831, *Radiological Guidelines for Application to DOE's Formerly Utilized Sites Remedial Action Program* (March 1983), described methods considered appropriate for the evaluation of health effects that might possibly be caused by radioactive contamination at FUSRAP sites. This assessment methodology was applied to a typical site for the purpose of deriving guidelines for the cleanup of contaminated soil. Therefore, the purpose of ORO-831 was to provide radiological guidelines for assessing the need for remedial action and for evaluating the sufficiency of any remedial action that might be undertaken as well as to identify the data and methods of analysis on which these guidelines were based.

In 1989, a manual for implementing DOE's residual radioactive material guidelines was developed, and the dose assessment methodology recommended for use in deriving site-specific soil guidelines was coded in a microcomputer program called RESRAD. The DOE guidelines were incorporated into DOE Order 5400.5, *Radiation Protection of the Public and the Environment*, in February 1990, and were included in proposed 10 CFR 834, *Radiation Protection of the Public and the Environment*, in March 1993. Since then, the manual and the code have been used widely by DOE and its contractors and, to some degree outside DOE, by the U.S. Nuclear Regulatory Commission (NRC) and licensing states. Comments received from users and new features have been incorporated into the code (Version 5.61). These improvements serve to ease the user's interaction with the code while increasing RESRAD's capability and flexibility.

In evaluating potential doses from residual radioactivity, one typically assesses the acceptability of the doses by constructing a source-term and exposure scenario and executing a computer model or analytical solution that simulates the release and transport of radionuclides and radiation in the environment. These assessments are performed on a site-specific basis and reflect differences in the characteristics of the residual radioactivity (e.g., nature, types, extent, and concentrations of radioactive contaminants) and of the environment (e.g., soil, surface water, groundwater, and air at the site). Unless there is a compelling reason to exclude specific exposure pathways based on these characteristics, a uniform set of exposure scenarios should be considered in evaluating whether residual radioactivity has been sufficiently reduced in accordance with regulations.

The common source term is assumed to be an uncovered contaminated soil zone of typically cylindrical shape. The radionuclide contaminants are assumed to be homogeneously distributed within the contaminated zone.

Geometry of Idealized Contaminated Zone



Many parameters that determine the quantity of radionuclides or radiation to which an individual is exposed are determined by exposure scenarios, that is, patterns of human activity that can affect the release of radioactivity from the contaminated zone and the amount of exposure received at the exposure location (see Exposure Pathways figure, next page). Three typical scenarios which are used in determining potential doses associated with residual radioactivity are:

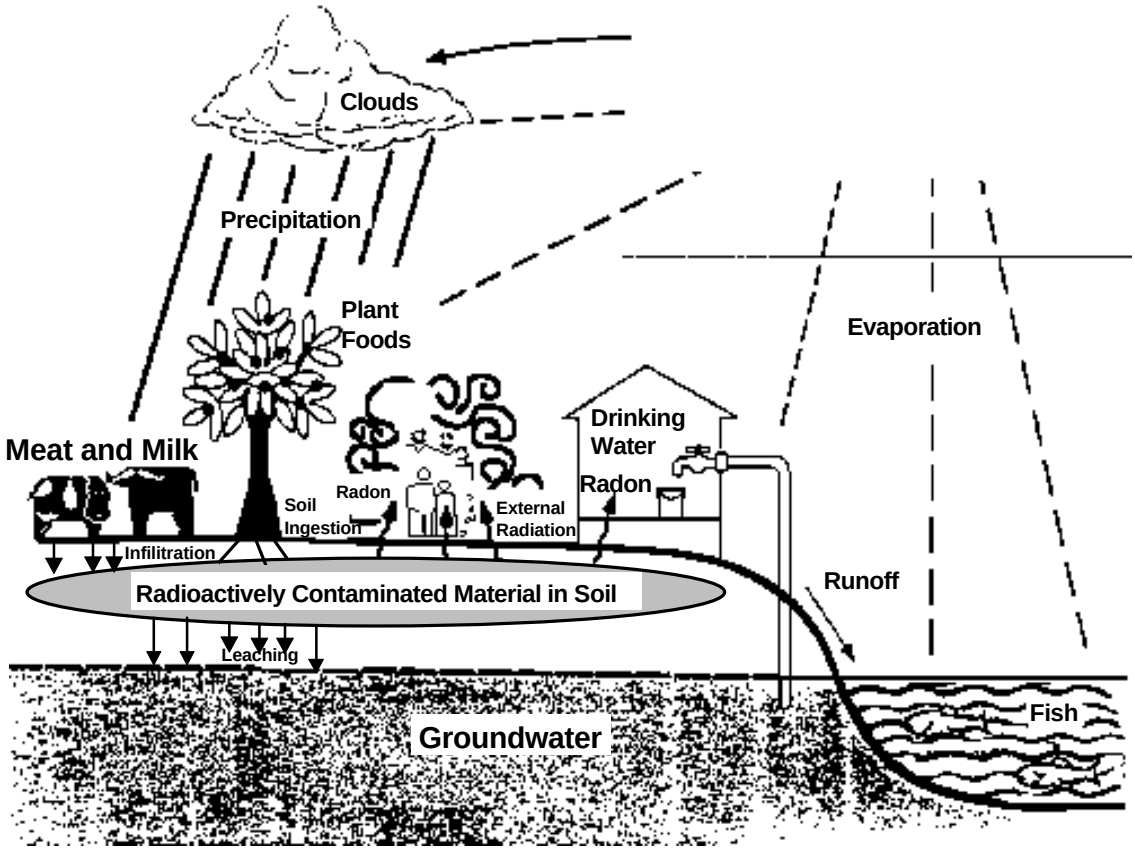
Scenario A — Represents typical exposures to a worker on site. The individual does not drink water from onsite or produce food for his/her personal consumption.

Scenario B — Represents a typical residential exposure for a homeowner who spends most of the time onsite. This individual also ingests drinking water, produced from a groundwater well onsite, as well as food grown in a garden onsite to supplement the diet.

Scenario C — This scenario is intended to represent the maximum reasonably exposed individual. Because the scenario is based on "prudently conservative" assumptions that tend to overestimate potential doses, use of this scenario should result in estimated doses that will be greater than the exposure to future residents most of the time. This individual spends long periods of time outside the residence (21%--5 hours per day for 365 days), grows and ingests a large percentage of vegetables from the onsite garden, consumes meat and milk produced onsite, and consumes aquatic food from a neighboring pond near the site.

These exposure scenarios can be readily assessed using commonly available computer codes, such as the RESRAD code. The RESRAD computer code is currently one of several codes used to independently confirm estimated doses associated with residual radioactive contamination.

Exposure Pathways



When a site is remediated, part of the problem is the radioactive waste. As indicated by its title, DOE Order 5820.2A, *Radioactive Waste Management*, establishes policies, guidelines, and minimum requirements for DOE's management of its radioactive and mixed waste and contaminated facilities. Following is a summary of this document:

DOE Order 5820.2A, *Radioactive Waste Management*	
Purpose	Establishes policies, guidelines, and minimum requirements by which DOE manages its radioactive and mixed waste and contaminated facilities.
Scope	Applies to all DOE elements, and, as required, all DOE contractors and subcontractors performing work that involves management of radioactive waste and/or radioactively contaminated facilities for DOE.

DOE Order 5820.2A, *Radioactive Waste Management* (cont.)	
Requirements/ Key Words	Chapter I, High-Level Waste (HLW) • Establishes policies and guidelines for managing HLW; subject to Atomic Energy Act (AEA) and the Resource Conservation and Recovery Act (RCRA). • All HLW generated by DOE operations shall be safety stored, treated, and disposed of according to DOE Order 5820.2A. Storage operations shall comply with Environmental Protection Agency (EPA) standards and EPA/state regulations. Geologic disposal shall comply with both Nuclear Regulatory Commission (NRC) regulations and EPA standards. • Requirements - Design requirements for new facilities and design review for existing facilities - Storage operations for doubly contained systems - waste characterization; storage and transfer operations; monitoring, surveillance, and leak detection; contingency action; training; quality assurance; and waste treatment and minimization - Storage operations for singly contained tank systems - waste characterization; storage and transfer operations; monitoring, surveillance, and leak detection; contingency action; training; and quality assurance - Disposal of new and readily retrievable existing HLW and other waste Chapter II, Management of Transuranic (TRU) Waste • Establishes policies and guidelines for managing DOE TRU waste starting with its generation, continuing through closure of the Waste Isolation Pilot Plant (WIPP), and finally ending with the management of buried TRU waste. TRU wastes that are also mixed wasted are subject to AEA and RCRA requirements. Buried TRU wastes are subject to the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the Superfund Amendments and Reauthorization Act (SARA). • TRU waste shall be managed to protect the public, worker health and safety, and the environment; and management shall be performed in compliance with radiation protection and environmental standards. • Requirements - Waste classification - TRU waste generation and treatment - TRU waste certification and packaging - Temporary storage at generating sites - Transportation/shipping to the WIPP - Interim storage designation and new interim storage-facility requirements - WIPP - Buried TRU-contaminated waste - Quality assurance

DOE Order 5820.2A, *Radioactive Waste Management* (cont.)	
Requirements/ Key Words (cont.)	Chapter III, Management of Low-Level Waste (LLW) • Establishes policies, requirements and guidelines for managing DOE's solid LLW. • LLW operations shall be managed to protect the health and safety of the public, using waste-generation reduction, segregation, treatment, and disposal practices to maximize cost-effectiveness. LLW will be disposed of on the site of generation if possible or at another DOE disposal facility, and mixed waste will conform to appropriate orders and regulations. • Requirements - Performance objectives to protect public health and safety and the environment - Performance assessment to demonstrate compliance with stated objectives - Waste generation requirements to reduce the volume of waste and/or amount of radioactivity requiring disposal - Waste characterization to permit proper segregation, treatment, storage, and disposal - Waste-acceptance criteria - Waste treatment, shipment, long-term storage - Disposal, disposal site selection, disposal facility and disposal site design - Disposal facility operations, site closure/post closure - Environmental monitoring, quality assurance, and records and reports Chapter IV, Management of Waste Containing Naturally-Occurring and Accelerator-Produced Radioactive Material (AEA 11e(2) Byproduct Materials) • Establishes policies and guidelines for managing DOE waste containing byproduct material, as defined by section 11e(2) of the Atomic Energy Act of 1954, as amended, and naturally-occurring and accelerator-produced radioactive material • DOE wastes of this category shall be stored, stabilized in place, and/or disposed of consistent with 40 CFR 192 guidelines. Small volumes of DOE waste containing 11e(2) byproduct material may be managed as low-level waste in accordance with Chapter III of this Order. (If mixed waste, management must also comply with RCRA.) • Requirements for waste management and quality assurance Chapter V, Decommissioning of Radioactively Contaminated Facilities • Establishes policies and guidelines for the management, decontamination, and decommissioning of radioactively contaminated facilities under DOE ownership and control. • Radioactively-contaminated DOE facilities shall be managed in a safe, cost-effective manner to ensure that release of and exposure to radioactivity and other hazardous materials comply with Federal and state standards. Facilities, equipment, and valuable materials shall be recovered and reused when practical.

DOE Order 5820.2A, *Radioactive Waste Management* (cont.)	
Requirements/ Key Words (cont.)	Chapter V, Decommissioning of Radioactively Contaminated Facilities (cont.) • Requirements - General program development and documentation - Facility design - Postoperational activities include potential for reuse and recovery of materials and equipment based on maintaining employee and public health and safety, environmental protection, and compliance with Federal and other requirements. - Decommissioning project activities include facility characterization, environmental review processes, engineering planning, operations, and postdecommissioning activities. - Quality assurance requirements include compliance with national consensus standards such as the American National Standards Institute (ANSI) and the American Society of Mechanical Engineers (ASME). Chapter VI, Waste Management Plan Outline • Provides guidance on the development and maintenance of a waste management plan for each site that generates, treats, stores, or disposes of DOE waste. • Discussion - The primary purpose of the waste management plan is to compile and consolidate an annual report on how waste management operations are conducted, what facilities are being used to manage wastes, what forces are acting to change current waste management systems, and what plans are in store for the coming fiscal year. • Format for waste management plans - Executive summary - General site information such as organization and site description - Radioactive and mixed waste management operations, systems, facilities, waste characteristics, problems, recommendations, and future direction of the site operations - Hazardous waste management (DP facilities) - Schedule and cost summary - Environmental monitoring programs - Related subjects Attachments • References • Definitions

3. Self-Study Scenarios/Activities and Solutions

Review

- ORO-831, *Radiological Guidelines for Application to DOE's Formerly Utilized Sites Remedial Action Program*
- ANL/EAD/LD-2, *Manual for Implementing Residual Radioactive Material Guidelines Using RESRAD, Version 5.61*
- DOE 5820.2A *Radioactive Waste Management*

Activity 1

Complete the following summary of exposure pathways table for Scenarios A, B, & C (found on. p. RP 2.10-4) with a yes or no to indicate if each of the pathways apply to each of the scenarios.

Your Solution:

Pathway	**Scenario A**	**Scenario B**	**Scenario C**
Example: External Exposure	Yes	Yes	Yes
Inhalation (Resuspension)			
Radon Inhalation			
Ingestion of Ground Water			
Ingestion of Vegetables			
Ingestion of Meat			
Ingestion of Milk			
Ingestion of Aquatic Food			
Ingestion of Soil			

Activity 1, Solution

Pathway	**Scenario A**	**Scenario B**	**Scenario C**
External Exposure	Yes	Yes	Yes
Inhalation (Resuspension)	Yes	Yes	Yes
Radon Inhalation	Yes	Yes	Yes
Ingestion of Ground Water	No	Yes	Yes
Ingestion of Vegetables	No	Yes	Yes
Ingestion of Meat	No	No	Yes
Ingestion of Milk	No	No	Yes
Ingestion of Aquatic Food	No	No	Yes
Ingestion of Soil	No	Yes	Yes

Activity 2

In order to increase your familiarity with DOE Order 5820.2A, review the Order to locate answers to the following questions. List your findings on the chart below

Questions	Answer Location in DOE 5820.2A
Example: What are the responsibilities of Assistance Secretary for Environment, Safety and Health (EH-1)	Section 8.e.
1. What is LLW?	
2. What are the objectives of the DOE LLW program?	
3. What principal waste management documentation is required?	
4. What is required in a waste management plan?	
5. What is DOE's policy on HLW?	
6. What are the evaluation requirements for HLW that is not retrievable?	
7. When should material suspected of being contaminated with TRU radionuclides be evaluated?	
8. Who is responsible for certifiability of the waste form, waste package content, and proper marking, labeling, and placarding of a shipment from an interim storage site to WIPP?	
9. Where are large quantities of LLW (byproduct) allowed to be disposed?	
10. What federal regulations govern decommissioning project activities?	
11. Where is waste minimization addressed for DOE LLW generators? (3 Sections)	
12. What documentation must be prepared after decommissioning operations are completed?	

Activity 2, Solution

Questions	Answer Location in DOE 5820.2A
Example: What are the responsibilities of Assistance Secretary for Environment, Safety and Health (EH-1)	Section 8.e.
1. What is LLW?	Attachment 2, Page 3, #20 (Definitions)
2. What are the objectives of the DOE LLW program?	Chapter III-1, Section 3.a. (Performance Objectives)
3. What principal waste management documentation is required?	Attachment VI-1, Page 5
4. What is required in a waste management plan?	Chapter VI (Waste Management Plan Outline)
5. What is DOE's policy on HLW?	Chapter I-1, Section 2. (Policy)
6. What are the evaluation requirements for HLW that is not retrievable?	Chapter I-8, Section 3.d.(2)
7. When should material suspected of being contaminated with TRU radionuclides be evaluated?	Chapter II-1, Section 3.a.(1)
8. Who is responsible for certifiability of the waste form, waste package content, and proper marking, labeling, and placarding of a shipment from an interim storage site to WIPP?	Chapter II-8, Section 3.g.(7)(c)
9. Where are large LLW (byproduct) allowed to be disposed?	Chapter IV-1, Section 3.a.(1) and (2)
10. What federal regulations govern decommissioning project activities?	Chapter V-3, Section 3.d.(1), (2), and (3)
11. Where is waste minimization addressed for DOE LLW generators? (3 Sections)	Chapter III-1, Section 2.b. Chapter III-2, Section 3.b.(2) Chapter III-2-3, Section 3.c.(1), (2), and (4)
12. What documentation must be prepared after decommissioning operations are completed?	Chapter V-5, Section 3.d.(5)(a) and (b)

4. Suggested Additional Readings and/or Courses

Readings

- U.S. Department of Energy (1983). *Pathways Analysis and Radiation Dose Estimates for Radioactive Residues at Formerly Utilized MED/AEC Sites* (ORO-832).
- U.S. Nuclear Regulatory Commission (1994). *Scenarios for Assessing Potential Doses Associated with Residual Radioactivity* (PG-8-08).
- DOE Order 5400.5, *Radiation Protection of the Public and the Environment*
- 10 CFR 834, *Radiation Protection of the Public and the Environment; Proposed Rule*

Courses

NOTE: See Appendix B for additional course information

- *DOE Facility Deactivation, Decontamination, Decommission Dismantlement* -- DOE.
- *Radiological Surveys in Support of Decommissioning* -- Oak Ridge Institute for Science and Education.
- *Radiation Protection Functional Area Qualification Standard Training* -- GTS Duratek.

Questions

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NOTES: